Spectrum Compatibility Measurements

Outputs

- Interference threshold measurements on a variety of Federal Government radar systems.
- Data reports for other US agencies and international forums on results of the interference measurements.

A significant percentage of spectrum between 400 MHz and 18 GHz is allocated for the use of radar systems on a primary basis. Radar receivers are noise-limited in their performance (i.e., radar receivers are designed to be highly sensitive to listen for faint echoes from small, distant, target objects), and external noise sources that exceed critical levels will degrade radar receiver performance. Therefore the bands within which radars operate must be kept as radio-quiet as possible. In recent years spectrum managers and design engineers have experienced pressure to find technical methods by which radar receivers might share spectrum with communication systems. If such proposals are ever to be implemented, it will be necessary to understand precisely the noise levels at which radar receivers begin to exhibit measurably degraded performance. The introduction of new systems into radar bands should result in cumulative noise effects that would stay below the critical interference thresholds of radar receivers.

Within NTIA, the Office of Spectrum Management (OSM) has worked with ITS for the past two years to determine the critical interference levels at which a variety of radar systems experience degraded performance. Some analyses have been theoretical, but a large body of tests and measurements have been performed to verify and enhance the theoretical knowledge.

In FY 2002, OSM and ITS engineers continued this series of measurements in collaboration with other Federal Agencies that included the Coast Guard, the Federal Aviation Administration (FAA) and the National Weather Service (NWS). Radars that were subjected to measurements included maritime surface search and navigation systems, long range air traffic control radars, airport surveillance radars, and a widely deployed model of weather surveillance radar.

At each radar installation, equipment was installed for the generation of a variety of interference modulation types. Analog interference included noise, continuous wave, and a variety of pulsed RF signals. Digital data-type signals included binary and quadrature phase-shift keyed (BPSK and QPSK), and gated QPSK (replicating time division multiple access, or TDMA). All types of interference were normally injected into the radar receivers at their RF input ports via hardline connections. Interference levels were varied by the test personnel to determine levels at which interference occurred.

For each type of interference, radar test targets were injected at controlled levels. Target levels were set close to radar receiver noise, but were kept high enough to provide a high probability of detection in the absence of interference. Baseline probability of detection was recorded in the absence of interference. Interference levels were then gradually increased while target detection probability was monitored.

At the end of each series of measurements, curves were generated showing probability of detection of radar targets as a function of interference level. These curves showed the thresholds at which radar performance began to show observable degradation.

The results of the measurements have been used in US Administration Contributions to the International Telecommunication Union — Radiocommunication Sector Working Party 8B (ITU-R WP 8B). It is anticipated that this work will ultimately result in accurate determinations of interference thresholds for most types of radar in all bands in which sharing with other services is being proposed.

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NTIA engineers from ITS and OSM set up equipment for injection of interference signals into an air traffic control radar (photograph by F.H. Sanders).